HEMOGLOBIN AND MCV VALUES IN 4,074 HEALTHY BLACK CHILDREN AND ADOLESCENTS

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Hemoglobin and mean corpuscular volume values appear to be lower among black than among white children. Blood hemoglobin concentration and red cell mean corpuscular volume were measured in 4,074 black boys and girls aged 1 through 20 years who lived near sea level. This is the largest hematologic survey of healthy American black children and adolescents to date. Children with sickle cell disease and elevated hemoglobin F were excluded from the study, but children with the traits for hemoglobin S, hemoglobin C, thalassemia, and iron deficiency were not. The 3rd and 97th percentile values reported here are close to the 95 percent confidence limits, and are adjusted for age and sex.

A large group of healthy, black, urban Americans living close to sea level who requested sickle cell screening from a mobile health unit were studied.[1,2] Hemoglobin and red cell volume standards derived from an extensive database have not been previously available for black children, who are known to exhibit consistently lower mean hemoglobin values than white children. The red blood cell values from the children and adolescents in the study group are presented in the hope that these data may be useful for nutritionists, epidemiologists, and other public health personnel.

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STUDY POPULATION AND METHODS

The study population consisted of 4,074 apparently healthy black children, 2,196 girls and 1,878 boys, ranging in age from 1 to 20 years. Most were brought by their parents (but a number of older adolescents presented themselves) for sickle cell screening from a mobile health unit operating in Washington, DC, and the surrounding Maryland and Virginia counties.[3] All gave informed consent for screening for sickle cell disease and other anemias. The investigation was carried out from 1977 through 1980. Prevalence of the sickle cell trait in this American black population, which also included an additional 3,668 black adults, was 7.3 percent.

Capillary blood collected in heparinized tubes was analyzed using an electronic blood cell counter (JTB 700, J. T. Baker Instrument Division, Milford, Conn) in the mobile unit. The cell counter measured hemoglobin and mean corpuscular volume (MCV) values. Hematocrit and mean corpuscular hemoglobin levels were calculated by the machine. The cell counter was calibrated each day using commercial standards according to the manufacturer's specifications. All tests were carried out between 9:00 AM and 4:00 PM. Subjects were not required to fast before the procedure.

Laboratory results were subjected to statistical analysis using an IBM 370 computer and a standard statistical (SAS) software package. Children with sickle cell disease or with an AF hemoglobin electrophoretic pattern (δ β-thalassemia trait or the trait for hereditary persistence of fetal hemoglobin) were excluded from the analysis. Persons

TABLE 1. HEMOGLOBIN PERCENTILE AND MEAN VALUES OF 4,074 AMERICAN BLACK BOYS AND GIRLS

		Hemoglobin (g/dL) Percentile Values					
Age (yr)	Number	3rd	5th	50th	95th	97th	Mean
Boys							
1-2	70	10.9	10.9	12.1	13.4	13.4	12.1
3	322	10.3	10.8	12.0	13.5	13.8	12.1
4	444	10.9	11.1	12.3	13.6	13.8	12.3
5	135	10.8	11.0	12.4	13.6	13.8	12.4
6-10	189	10.9	11.3	12.6	14.1	14.4	12.6
11-15	255	11.3	11.6	13.5	15.1	15.3	13.5
16-20	463	12.4	12.8	14.8	16.7	17.0	14.8
Girls							
1-2	85	10.6	10.9	12.1	13.4	13.6	12.1
3	298	10.8	11.0	12.2	13.6	13.9	12.2
4	462	10.8	11.0	12.3	13.7	13.9	12.3
5	126	10.9	11.0	12.3	13.8	14.4	12.4
6-10	238	10.7	11.2	12.7	14.2	14.2	12.6
11-15	411	11.2	11.4	12.9	14.4	14.6	12.9
16-20	576	11.1	11.3	13.1	14.8	15.2	13.1

TABLE 2. MEAN CORPUSCULAR VOLUME (MCV) PERCENTILE AND MEAN VALUES OF 4,074 AMERICAN BLACK BOYS AND GIRLS

		MCV (fL) Percentile Values					
Age (yr)	Number	3rd	5th	50th	95th	97th	Mean
Boys							
1-2	70	68	70	81	89	90	80
3	322	69	72	83	92	93	82
4	444	72	74	85	94	96	85
5	135	71	72	83	91	91	82
6-10	189	71	73	84	93	95	84
11-15	255	72	75	86	97	98	86
16-20	463	75	78	90	100	102	90
Girls							
1-2	85	69	71	80	91	94	81
3	298	69	72	84	94	95	83
4	462	72	73	85	94	95	85
5	126	69	72	83	94	96	83
6-10	238	71	72	85	96	97	85
11-15	411	72	74	88	98	99	87
16-20	576	74	76	90	101	103	89

with values that were clearly the result of laboratory or transcription error were deleted from the original total of 7,782 subjects, which included adults. The number of subjects whose results were deleted was 40, or 0.5 percent of the total.

RESULTS

The percentile and mean values for hemoglobin and MCV for the study group are listed in Table 1 and Table 2. As expected, the red cell values in-

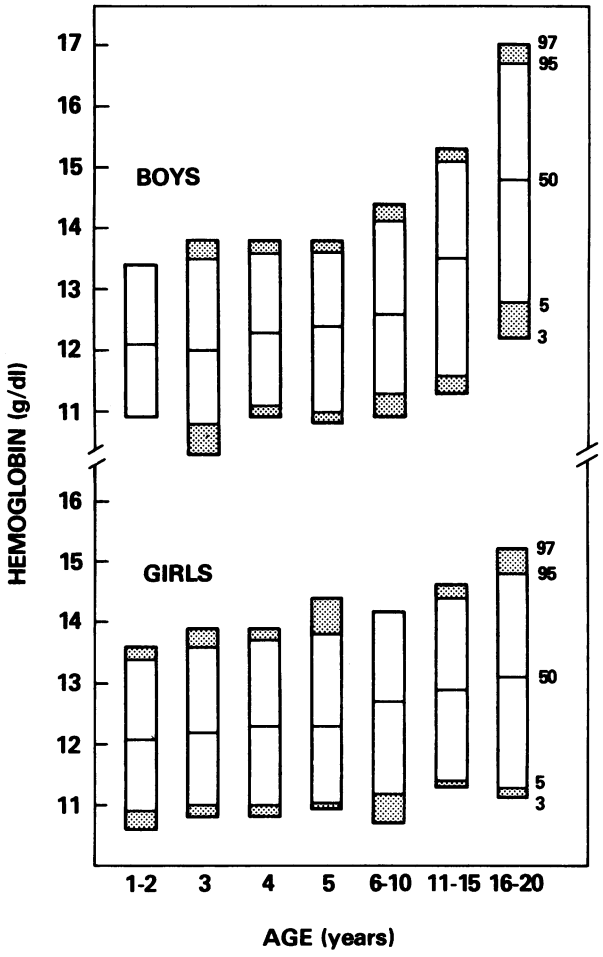

Figure 1. Hemoglobin percentile and mean values of 4,074 American black children according to age and sex. Among boys in the 1- to 2-year-age group, the values at the 3rd and 5th as well as the 95th percentiles are identical. Among girls in the 6- to 10-year-old age group, the 95th and 97th percentile values are identical

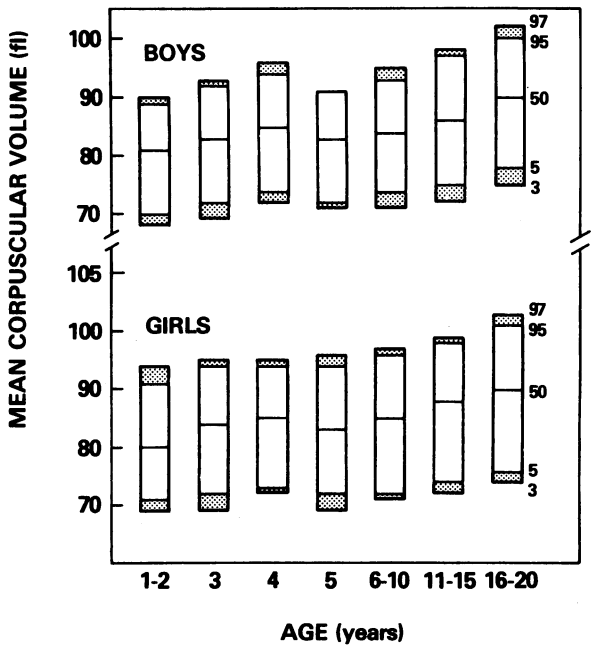

Figure 2. Mean corpuscular volume percentile and mean values of 4,074 American black children according to age and sex. Among boys in the 5-year-old age group, the 95th and 97th percentile values are identical

creased with advancing age. Essentially, no difference appeared between boys and girls until adolescence, when the hemoglobin values became higher in male than in female adolescents.

Hemoglobin and MCV percentile values in boys and girls are also displayed on the bar graphs in Figure 1 and Figure 2. Hemoglobin concentrations increased fairly steadily with age, except for a slight decrease in the 50th percentile value for 3-year-old boys (Figure 1). Similarly, MCV values increased with age, except for a distinct reduction at 5 years of age for both boys and girls (Figure 2). A similar drop in the hematocrit and mean corpuscular hemoglobin levels was observed at 5 years of age for children of both sexes (data not shown). The 3rd and 5th percentiles for hemoglobin values in girls in the 16- to 20-year-old age group were lower than those in 11- to 15-year-old girls. This difference was not observed in boys of the same age groups.

DISCUSSION

The red blood cell values presented here are derived from a study population consisting of 4,074 individuals, the largest hematologic survey of black children and adolescents to date. The 3rd and 97th percentiles were selected as the outer limits of normal so as to encompass the 95 percent reference range. The 5th and 95th percentiles are also indicated in the tables and figures; less variability is encountered at these percentiles than at the extreme outer ranges.

The study results are similar to those found in 484 healthy black children aged 5 to 13 years at the San Francisco Kaiser-Permanente Medical Center (1973 to 1975).[4] Children with low MCV values, sickle cell and hemoglobin C traits, or glucose 6-phosphate dehydrogenase deficiency were excluded from that study population. The results reported herein are also comparable to those found in 314 black children aged 3 to 17 years who participated in the Second National Health and Nutrition Examination (NHANES II) from 1976 to 1980.[5] Children with low transferrin saturation, AS and AC hemoglobin phenotype, high hemoglobin F or A_2, low MCV, or high erythrocyte protoporphyrin were excluded from that analysis. Individuals with hemoglobin AS and AC were not excluded from the study population reported here.

Black children have long been known to have lower red blood cell values than white children.[6] Among the reasons for this are an increased incidence of iron deficiency[7] and high blood lead levels[8] as well as the presence of α- and β-thalassemia traits.[9,10] There may be further reasons that are not as yet fully defined. Testing for anemia is an important aspect of well-child care, but anemia is not always readily defined because low and subnormal hemoglobin and MCV values overlap. Oski and co-workers[11] showed that iron deficiency adversely affected the developmental scores of infants; the deficits were reversed following iron therapy. Webb and Oski[12] also showed that iron deficiency interfered with academic achievement in adolescents. If the lower limit for red blood cell values is set at too high a level, a number of children with anemia caused by iron deficiency will be missed and will be at risk for not performing their developmental tasks optimally. Criteria for the diagnosis of anemia in black children await a study in which iron deficiency is ruled out.

Acknowledgments

The study was partially supported by a National Institutes of Health grant, No. HL 15160. The mobile health laboratory was provided by the United Black Fund, Inc, of Greater Washington, DC. Melvin E. Jenkins, MD, chairman of the Department of Pediatrics and Child Health, Howard University College of Medicine, encouraged and supported the work of this study.

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